Breakout V: Surface and Interface Science

- One beamline with as many stations as possible will accommodate multiple generic types of systems. The stations will be configured to maximize beamline productivity and throughput.
  - Large instruments customized for various materials growth and processing techniques require extensive support facilities and are not easily moveable. Requires dedicated hutch.
  - Medium instruments also require significant support facilities. Can be moved, e.g. to swap processing systems, but significant setup time (days) is required.
  - Small systems that can be mounted on a four circle diffractometer or other standard piece of equipment. Modest setup time.
  - Ex-situ measurements. No significant setup time.

Surfaces and Interfaces: Current Scientific Themes

Time-resolved studies of thin film growth and processing (oxides, semiconductors, organic semiconductors, silicides).

In-situ surface structure.

Ex-situ surface & interface structure.

Studies of chemical, electronic, and magnetic state of surface.

In-situ mapping of inhomogenous surfaces and films.

Size of community

- Experience from APS
  - 1.5 undulators -- special purpose systems.
  - 1.3 undulators -- specialized chambers that fit on diffractometers.
  - 0.5 undulators -- ex situ measurements.
- 3.2 undulators total. 3X oversubscribed.

Science Case

- Continue and strengthen ongoing science in the following areas:
  - Time resolved studies of film/surface growth and processing.
  - Surface structure determination -- evolving into a routine measurement.
  - Use of resonance, etc. for the study of surface chemical, electronic and magnetic structure.
- Enhance these studies with an entirely new capability to focus beams to ~50 nm in order to do imaging and probe surfaces in the processing environment.
- Studies of dynamics using photon correlation spectroscopy will also become possible.

Preliminary Beamline Specifications

- High brightness undulator source.
- Energy range 2 - 25 keV.
- Choice of bandwidth: 1%, 0.01%, 2eV.
- Focussing elements for ~30 micron to ~50 nm at sample inside processing environment.
- Multiple end stations with various size/complexity growth and processing equipment.
- Ventillation, gas handling, fume hood, etc.
- Close proximity and easy access to LOB.
- Desks for students.

scale of ~1 micron. Structures through lithography and patterning.

Uniqueness

- Use the high brightness of the NSLS-II source to provide small beams in-situ; examine surfaces and films on this scale. Best resolution compatible with processing environment is ~20-50 nm.
- Simultaneously maintain highly parallel beams for diffraction contrast imaging.
- Capability of 0.2 eV energy resolution for chemical or magnetic contrast through resonance.
- Possible opportunities to partner with industry.

Beamline Layout

- Part or all of beamline external to NSLS-II building in order to accomodate large equipment, multiple hutches.
- Connection to LOM preferred.
- Other configurations (canted undulators, etc.) need to be considered.

R&D Needs

- Endstation design. Collaborate with APS?
- Phase retrieval for surface/interface structure determination.
- Detector development: Strip detectors, area detectors with special capabilities such as microsecond time resolution, energy resolution.